ACETABULAR RING PROSTHESIS WITH REINFORCEMENT BUTTRESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to medical orthopaedic surgical devices, and more particularly relates to an improved orthopaedic acetabular prosthesis with a reinforcement buttress to provide additional support for a cemented, all polyethylene cup prosthesis.

2. General Background

Acetabular defects have thus been treated by many different methods. Some of these methods include filling the void with bone cement; bone grafting; and implanting bipolar prostheses, custom designed implants, and cementless acetabular components. However, each of these methods has had problems treating massive bone deficiencies. Reinforcement rings are designed to address the failure modes seen in the previously mentioned methods. Reinforcement rings have been used clinically for many years to treat massive bone deficiencies. They can be used with or without bone grafts depending on the degree and position of the defect. Anti-protrusio cages are discussed in an article authored by Berry and Müller, entitled "Revision Arthroplasty Using An Anti-Protrusio Cage for Massive Acetabular Bone Deficiency," Journal of Bone and Joint Surgery, Vol. 74-B, No. 5, September 1992, pp. 711–715.

Some acetabular defects create problems for a surgeon when implanting an acetabular prosthesis. These defects often dictate that a artificial acetabular cavity be created to receive an artificial acetabular socket utilizing a grouting agent to secure the socket in place.

One of the problems with certain patients having pelvic defects is that of a lack of available host bone tissue for receiving and connecting to the prosthesis. Rings are used with screws fixated to either bone graft or host bone. Cement is then used with the "all poly" component.

In bone defect cases, cement does not always have proper support to hold the polyethylene or "poly" liner. Such bone defects can be in the form of gaps in the bone, or columnar defects such as a posterior column defect.

There are a number of commercially available acetabular prosthetic devices that include a cup shaped body. Reinforcement shells include Protek's Müller acetabular roof reinforcement ring and the Howmedica Oh-Harris Protrusio Shell. Reconstruction shells include Protek's H. B. Burch—R. Schneider Reinforcement Cage (C. P. Titanium), Protek's R. Ganz Acetabular Roof Reinforcement Ring with Hook (C. P. Titanium), and Osteonics' Gap Acetabular Cup (C. P. Titanium). Some of these acetabular cups have correspondingly shaped inner and outer concave and convex surfaces. Some devices have projections extending from the outer surface of the cup-shaped body. For example, U.S. Pat. No. 3,939,497 describes a socket for a hip joint prosthesis which is secured to a cavity in the bone tissue by a series of radially arranged pegs which can be projected outwardly from the wall of the socket into the surrounding tissue by a central screw which also has a self-tapping thread that enters the tissue.

European Patent Application No. 169,978 published May 2, 1986, describes an acetabular cup which has an outer shell embedded into the patient's pelvis. The outer shell has a frustro-conical skirt and a spherical central cap.

In European Patent Application No. 211,169 published Feb. 25, 1987, an acetabular cup is described in which an external boss protrudes from the outer surface of the acetabulum body to fit into a pre-drilled hole in the acetabulum.

Other foreign patents and patent applications which describe acetabular cups include European Patent Application No. 212,087 published Apr. 3, 1987, wherein metallic pins project from the surface of the cup and contain holes in which tissue may grow. In European Patent No. 341,198 published Nov. 8, 1989, an acetabular cup has a metal outer shell and a plastic body for retaining the hip joint head.

Some acetabular cup devices have outer surfaces with two differently shaped regions thereon including an annular rim or skirt that is thickened for forming an interference fit with the pelvis. Another acetabular cup (Patent DE 3341723C1) is in the form of a hemispherical socket body that is flattened at the crown region, to ensure lateral wedging of the socket in the pelvic bone.

SUMMARY OF THE INVENTION

The Acetabular Reinforcement/Reconstruction Shell System consists of a "Roof Reinforcement" shell and a "Reconstruction" shell. Both types have multiple screw holes for fixation. Acetabular Reinforcement/Reconstruction Shells are manufactured from commercially pure titanium in a variety of sizes to accommodate the needs of all patients. The metal shell is positioned with screws and then an all polyethylene component is cemented into place. By incorporating a construct that includes a metal shell, screws, cement and an all poly component, the system provides more strength than only cement or bone grafting.

The Reconstruction Shell consist of a full or partial cup shaped device with multiple angled and/or twisted flanges for fixation in the ilium or ischium. This device has a reinforcement cement buttress which acts as a form of support for the cemented all polyethylene cup which is typically left unsupported in this area. A third flange can be fixated to the posterior column.

The present invention thus provides an improved (cemented) acetabular prosthesis that includes a cup body having a thin wall with a cup body wall thickness of about 2 mm. The body has a concave surface, a convex surface, and an annular rim.

The concave surface of the ring allows for the use of a cemented "all poly" component. The polyethylene or "all poly" then accepts the femoral head of a hip stem.

The cup body wall provides a plurality of openings therethrough. Some of these openings are bone screw receptive openings that are reinforced with an annular reinforcement that extends away from the convex surface of the cup body. Others of the openings are openings that allow cement to flow through the concave and convex layers of the cup body. A threaded hole accepts a correspondingly threaded instrument that allows for ring insertion.

A cement mantle is used to affix the plastic liner within the cup body. The cement mantle flows through at least some of the openings upon use of the cup liner. Others of the openings that are reinforced are used for receiving bone screws that attach the cup body to the patient's pelvis.

In a first embodiment (acetabular roof reinforcement shell), at least one curved annularly extending flange extends away from the rim of the cup and helps attach the cup body to the patient's pelvis. The reinforcement buttress helps secure a mass of cement in between the cup body and the polymeric liner.

In a second embodiment (acetabular reconstruction shell), a plurality of radially and circumferentially spaced flanges

(preferably three) extend away from the cup body. One of the flanges is an inferior flange. Opposite the inferior flange are two additional flanges, a superior flange and a posterior flange. In the second embodiment, a buttress extends a partial distance around the rim of the cup and is preferably positioned adjacent to the superior and posterior flanges.

BRIEF DESCRIPTION OF THE DRAWINGS

For a further understanding of the nature and objects of the present invention, reference should be had to the following detailed description, taken in conjunction with the accompanying drawings, in which like parts are given like reference numerals, and wherein:

FIG. 1 is a top schematic view of the first embodiment of the apparatus of the present invention;

FIG. 2 is another top view of the first embodiment of the apparatus of the present invention after the application of bone cement and prior to receiving the plastic liner;

FIG. 3 is schematic perspective view of the first embodiment of the apparatus of the present invention showing the plastic polymeric liner in its cemented position;

FIG. 4 is another perspective view of the first embodiment of the apparatus of the present invention showing the liner in cemented position;

FIG. 5 is a side view of the first embodiment of the apparatus of the present invention showing the cup body;

FIG. 6 is a bottom perspective view of the first embodiment of the apparatus of the present invention showing the cup body;

FIG. 7 is another side view of the first embodiment of the apparatus of the present invention showing the cup body;

FIG. 8 is a bottom view of the first embodiment of the apparatus of the present invention;

FIG. 9 is a top view of the first embodiment of the apparatus of the present invention;

FIG. 10 is a front view of the first embodiment of the apparatus of the present invention;

FIG. 11 is a rear view of the first embodiment of the apparatus of the present invention;

FIG. 12 is a top perspective view of the second embodiment of the apparatus of the present invention;

FIG. 13 is a top view of the second embodiment of the apparatus of the present invention;

FIG. 14 is a bottom view of the second embodiment of the apparatus of the present invention;

FIG. 15 is a top perspective view of the second embodiment of the apparatus of the present invention;

FIG. 16 is a side view of the second embodiment of the apparatus of the present invention;

FIG. 17 is another side view of the second embodiment of the apparatus of the present invention;

FIG. 18 is an end view of the second embodiment of the apparatus of the present invention; and

FIG. 19 is another end view of the second embodiment of the apparatus of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. 1 and 2 show the first embodiment of the apparatus of the present invention designated generally by the numeral 10. Acetabular prosthesis 10 includes a cup body 10A that can be placed in the acetabulum of a patient's pelvis 1 as shown in FIGS. 1 and 2. In FIGS. 3 and 4, a plastic liner 11 has been placed into concave surface portion 12B of the cup body 10A. A mass of cement C is then used to hold the polyethylene "all poly" plastic component 11 to the cup body 10A after the cup body 10A has been secured to the patient's pelvis 1 as will be described more fully hereinafter.

In FIGS. 5–11, the first embodiment of the apparatus of the present invention is shown, designated generally by the numeral 10A. The cup body 10A has a pair of opposed surfaces 12A, 12B. The surface 12A is an outer surface that will abut the patient's acetabulum. The surface 12B is an inner surface that will abut and receive the plastic liner 11. A rim surface 13 extends a partial distance around the cup body 10A. Rim surface 13 defines a flat plane 13A.

Flange 14 has a reverse curve portion 15 that joins with cup convex surface 12A, as shown in FIGS. 5 and 7. Flange 14 has end portions 16, 17 that define the transition connection to annular rim 13 of cup body 10A. Flange 14 has a pair of opposed outer edges 18, 19. The outer edges 18, 19 can be parallel.

Flange 14 has a lower surface 20 and a periphery 21. A curved buttress 22 is attached to flange 14 at its lower surface 20. This can be a one piece integral construction. Wall 22 has a curved outer surface 23 and a curved inner surface 24.

A flat plane 25 is defined by surface 20 of flange 14. In FIG. 5, the plane 25 of flange 14 and the plane 13A of rim 13 form an obtuse angle of about 147 degrees.

A number of openings are formed through cup body 10A. These openings include reinforced openings as well as unreinforced openings. One of the openings is in the form of an arcuate slot 26. Openings 27 are reinforced openings, being surrounded by a thickened portion of the cup body 10A at opening 27 in the form of an annular boss 28. Opening 29 is a threaded hole opening, having no reinforcement or annular boss 28 that surrounds it. Opening 29 is threaded to accept a positioning instrument for properly locating and impacting the cup body 10A.

Openings 30 are a plurality of openings, as shown in FIGS. 6 and 9, 10 and 11, that are formed through the reverse curved portion of the cup body 10A that forms a transition between flange 14 and the remainder of the cup body 10A, as shown in FIGS. 5 and 7.

FIGS. 12–19 show a second embodiment of the apparatus of the present invention designated generally by the numeral 50. In FIG. 12, the cup prosthesis 50 is shown mounted in a patient's pelvis 1 at the acetabulum. The prosthesis 50 includes a cup body 51 that attaches to the pelvis 1 using a plurality of radially extending and circumferentially-spaced flanges 53, 54, 55.

In FIGS. 13–19, the three flanges 53, 54, and 55 are shown extending from the rim 52 of cup body 51. The flange 53 is the superior flange. The flange 54 is the posterior flange. The flange 55 is the inferior flange.

The cup body 51 has an inner concave surface 51A that receives bone cement which receives an acetabular socket 11 as with the first embodiment 10. The cup body 51 also provides a convex surface 51B that fits the patient's acetabulum. Annular rim 52 extends around the periphery of cup body 51. Flanges 53, 54, 55 extend from annular rim 52 and are radially extending and circumferentially spaced about the rim 52 as shown in FIG. 13. Each of the flanges 53–55 provides one or more bone screw openings. The flange 53 has a plurality of openings 56. The flange 54 has a plurality of openings 57. The flange 55 has a plurality of openings 58. The openings 56–58 can be used to fasten the cup body 51 to the patient's pelvis 1 using fasteners such as the bone screws B shown in FIG. 12.